FROM: AFCESA/CESC
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SUBJECT: **ETL 98-XX, Airfield Pavement Condition Assessment Standards**

1. Purpose. This ETL provides a standard procedure for identifying/validating airfield pavement projects for the Facility Investment Metric (FIM), prioritizing projects within FIM categories, and assigning a "health" rating to pavement facilities (Runways, Taxiways, Aprons) or to entire airfields. The basic element of the assessment is the Pavement Condition Index (PCI), modified by structural capability, skid potential and foreign object damage (FOD) potential.

2. Application. This ETL applies to all Air Force organizations conducting surveys of airfield pavements. The ETL is for guidance only.

2.1. Effective Date. Immediately. Expires in five years.

2.2. Ultimate Recipients.
    -Base Civil Engineers and MAJCOMs conducting facility assessments for FIM.

3. REFERENCES:

Air Force Facility Investment Metric Implementation and Operations Guide,
 1 August 1997

AFI 32-1041, *Airfield Pavement Evaluation*

AFJMAN 32-1036, *Pavement Evaluation for Airfields*

AFR 93-5, *Procedures for Airfield Condition Surveys (Future AFJMAN 32-1038)*

ASTM D 5340-93, *Test Method for Airport Pavement Condition Index Surveys*

ETL 97-14, *Procedures for Airfield Pavement Condition Index Surveys*

FAA AC No: 150/5320-12C, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces,* 18 March 1997

4. BACKGROUND.

4.1. General. This ETL was developed in response to a need to develop an objective method to determine facility impact ratings and prioritize multiple requirements to repair airfield pavements.

4.1.1. The Base/MAJCOM determines the appropriate category for each airfield pavement facility based on *Air Force Facility Investment Metric Implementation and Operations Guide, 1 August 1997*. Primary pavements (those absolutely necessary to perform the mission) and possible other pavements should fall in the "Primary Mission" category.

4.1.2. The criteria in paragraph 5 are used to determine or validate if the facility rating is "Minimal, Degraded, or Critical." It is anticipated that there will be numerous projects in each category, with most in the "Primary Mission – Degraded" category of the Mission Area Requirements Matrix (MARM).

4.1.3. The criteria in paragraph 6 are used to prioritize projects within each category.

4.1.4. Some MAJCOMs have indicated a desire to establish a numerical rating for pavement systems and entire airfields that will allow them to compare systems or airfields throughout the command and to assess the impact of projects. The criteria in paragraph 7 can be used for this purpose.

4.2. Pavement Condition Surveys. The source for information on condition survey, pavement distress types and severity levels comes primarily from AFR 93-5, ASTM D 5340-93, and ETL 97-14.   Background information is provided here to aid in understanding the pavement rating system and terminology.

4.2.1.   Pavements are rated on a scale of 0 (failed) to 100 (perfect, no faults) using a visual assessment system which categorizes distresses in a pavement system by type of distress, density of distress and severity of the distress. The PCI value and pavement rating from AFR93-5 are shown here for information.

PCI	Rating
100	
	Excellent
85	
	Very Good
70	
	Good
55	
	Fair
40	
	Poor
25	
	Very Poor
10	
	Failed
0	

4.2.2. Bases/MAJCOMS must arrange to conduct condition surveys and assure that most recent condition survey information reflects the condition of the airfield pavement. Where current PCI data does not reflect the true condition of a pavement feature, bases should conduct condition surveys of individual pavement features to assure accurate assessments. Surveys are required every 5 years in accordance with AFI 32-1041. In addition, AFI 32-1032, *Planning and Programming Real Property Maintenance Projects using Appropriated Funds (APF)* requires a PCI for projects submitted to MAJCOMs for approval.

4.2.3. Pavement condition survey training is available through the Air Force Institute of Technology (AFIT), Wright-Patterson AFB OH, US Army Corps of Engineers-Construction Engineering Research Laboratory (USACE-CERL), and through the University of Illinois Continuing Education Program. Surveys can be accomplished in-house or by contract. On-call contracts available at HQ AFCESA can also provide these services. MAJCOM pavement engineers should be consulted prior to awarding contracts for surveys and/or training.

4.3. FOD Potential. At certain locations, FOD potential is one the primary factors for determining the serviceability of a pavement area. To highlight potential FOD problems, a new FOD potential rating was created. The FOD potential is based on only certain distresses in the PCI system, as described in paragraph 5. FOD Potential ratings should be determined from the most current Pavement Condition Survey.

4.4. Skid/Hydroplaning Potential. If a runway surface is wet and lacks good friction resistance, aircraft can hydroplane or experience poor braking performance. AFCESA conducts Friction Characteristics Evaluations to determine the friction along the length of the runway. The criteria used for judging hydroplaning potential come from Federal Aviation Administration Advisory Circular AC 150/5320-12B.

4.5. Structural Index. When constructed, airfield pavements are designed to support a certain aircraft load for a number of traffic crossings. After construction, pavements are evaluated to determine the actual thickness and strength of the in-place pavements and supporting soils. AFCESA conducts these evaluations at all Air Force bases approximately every 10 years. Using the in-place data, AFCESA calculates Pavement Classification Numbers (PCN) for every airfield pavement feature. The structural index is a comparison of the Aircraft Classification Number (ACN) to the PCN.

5. AIRFIELD PAVEMENT ASSESSMENT PROCEDURES. This section describes a procedure for identifying or validating maintenance and repair requirements for an airfield pavement (i.e. runway, apron, or taxiway) based on four factors: PCI, FOD potential, Skid/Hydroplaning potential, and Structural Index.

5.1. Determine Rating Factors for Each Pavement Feature

5.1.1. PCI. Review the most recent airfield pavement condition survey report. Conduct PCI surveys on airfield pavements that need updating if the current condition is not accurately reflected in the latest airfield pavement condition survey report.

5.1.2. FOD Potential. Determine the FOD potential of pavement distresses using the PCI Survey. Only consider distresses that have a **density greater than one-percent as determined by the MicroPAVER program, and the scope exceeds in-house repair capability.**

5.1.2.1. Distresses capable of producing FOD are listed below:

5.1.2.1.1. Portland Cement Concrete (PCC) Pavement. Blow-up, corner break, joint seal damage, popouts, scaling, spalling (joint and corner), patching, cracking (divided/shattered slabs, longitudinal, diagonal, transverse and durability cracking).

5.1.2.1.2. Asphalt Concrete (AC) Pavement. Alligator cracking, longitudinal and transverse cracking, block cracking, jet blast erosion, joint reflection cracking, oil spillage, patching, raveling/weathering, slippage cracking and shoving.

5.1.2.2. FOD Potential Ratings.

5.1.2.2.1. Low FOD Potential. The pavement has low severity FOD distresses at any density **and** all individual medium or high severity FOD distresses are less than 1% density.

5.1.2.2.2. Moderate FOD Potential. The pavement has low severity FOD distresses at any density, medium severity FOD distresses at greater than 1% density, and high severity FOD distresses at less than 1% density.

5.1.2.2.3. High FOD Potential. The pavement has low and medium severity distresses at any density and high severity distresses at greater than 1% density.

5.1.2.3. A FOD Index number is under development by the US Army Corps of Engineers—Construction Engineering Research Laboratory. In future versions, MicroPAVER will automatically calculate the FOD Index on a scale from 0 to 100, with 0 indicating no FOD potential and 100 indicating maximum FOD potential. This development will also include determining a breaking point between low, moderate, and high FOD potential. This ETL will be updated when the new system is available.

5.1.3. Skid/Hydroplaning Potential. Review the most recent Friction Characteristics Evaluation Report for the base runway(s) to determine the skid/hydroplaning potential of runway pavements. Pavements are considered to have low, moderate or high skid/hydroplaning potential under the friction conditions listed below. Note:

In the past, AFCESA has used the Mu-meter to determine skid/hydroplaning potential. A new testing device, the Griptester, may be used in the future and has slightly different maintenance planning and minimum friction levels.

5.1.3.1. Divide each runway feature into 500 foot segments and determine an average Mu-Meter value for each segment at both testing speeds. Compare that value to the chart below. If the friction value at different speeds indicates two different categories, assign the more severe category to the segment. Assign the lowest segment rating to the entire pavement feature.

Skid/ Hydroplaning Potential	Mu-meter 40 mph	Mu-meter 60 mph	Griptester 40 mph	Griptester 60 mph
LOW	> 0.52	> 0.38	> 0.53	> 0.36
MODERATE [1]	Between 0.42 and 0.52	Between 0.26 and 0.38	Between 0.43 and 0.53	Between 0.24 and 0.36
HIGH [2]	< 0.42	< 0.26	< 0.43	< 0.24

Notes: 1. for a distance of 1000 ft or more
2. for a distance of 500 ft or more

5.1.4. Structural Index. Review the latest HQ AFCESA airfield pavement structural evaluation report to determine if any significant portions of the airfield pavement system are overloaded (ACN/PCN > 1.0). A PCN code should be listed for every pavement feature. Pavements are considered overloaded when the ACN/PCN ratio is greater than 1.0. When calculating the ACN/PCN ratio, use an ACN for the most critical mission aircraft at its maximum takeoff weight.

5.2. Determine Rating for Each Feature. Because airfield pavements are mission essential, it is important that the pavement condition be maintained to a high standard. The Air Force has traditionally used a PCI of 70 as the minimum goal. However, other factors, such as friction characteristics for runways, structural adequacy and FOD potential, are also important considerations. The standard rating procedure for airfield pavements uses the PCI as the basic rating criteria, with adjustments when these other factors do not meet specified criteria. Ratings of **Adequate, Marginal, or Unsatisfactory (Can be directly associated with FIM ratings of Minimal, Degraded, or Critical)** are assigned to each airfield feature based on the criteria in the following table. **Example:** A feature is rated **Adequate** if the PCI is 70-100, provided Mu-meter (40mph) friction (Mu) is greater than or equal to 0.52, Mu-meter (60mph) friction (Mu) is greater than or equal to 0.38, ACN/PCN is less than 1.25, and distresses associated with FOD are less than 1% and/or are all low severity. **Note: FOD Potential data may not be readily available. If this is the case, it is recommended that only Mu and ACN/PCN modifiers be used. FOD information will be available in future Micro-Paver reports.**

RATING/ ASSESSMENT CATEGORY	Pavement Condition Index (PCI)	Skid/ Hydroplaning Potential Friction (Mu) Measurement (Runways Only)	Structural Adequacy ACN/PCN	Foreign Object Damage (FOD) Potential
Adequate (Minimal)	PCI=100 PCI>70	Mu-meter (40mph)$\geq$0.52 Mu-meter (60mph)$\geq$0.38 Griptester (40mph)$\geq$0.53 Griptester (60mph)$\geq$0.36	ACN/PCN< 1.25	Medium or High Density <1% or Low Severity FOD Distresses
Marginal (Degraded)	PCI>55	Mu-meter (40mph)>0.42 Mu-meter (60mph)>0.26 Griptester (40mph)>0.43 Griptester (60mph)>0.24	1.25<ACN/ PCN <1.50	Medium Severity FOD Distresses, Density >1%
Unsatisfactory (Critical)	PCI$\leq$55 or any PCI with associated modifiers	Mu-meter (40mph)$\leq$0.42 Mu-meter (60mph)$\leq$0.26 Griptester (40mph)$\leq$0.43 Griptester (60mph)$\leq$0.24	ACN/PCN $\geq$1.50	High Severity FOD Distress, Density > 1%,

5.3. Determine Overall Facility Rating. Features may be grouped together as part of one facility or requirement. The rating for the facility or requirement is equal to the lowest rating of the individual features.

5.4. Standard Pavements Assessment Example:

Facility	Feature	PCI	Mu(40)	Mu(60)	ACN/PCN	FOD	Rating
Runway	R01A	78	0.55	0.40	0.88	<1%	**Adequate**
	R02C	87	**(0.50)**	0.38	0.88	<1%	**Marginal**
	R03A	76	**(0.50)**	0.45	**(1.25)**	<1%	**Marginal**
	R04A	72	**(0.45)**	0.40	**(1.4)**	**(1.5% H)**	**Unsatisfactory**
(#.##) Indicates does not meet **Adequate** requirements							

Runway Overall Rating: **Unsatisfactory (lowest feature rating)**

Facility	Feature	PCI	Mu(40)	Mu(60)	ACN/PCN	FOD	Rating
Taxi A	T01A	83	N/A	N/A	1.0	<1%	**Adequate**
	T02A	**(57)**	N/A	N/A	0.9	<1%	**Marginal**
Taxi B	T03A	75	N/A	N/A	0.85	<1%	**Adequate**
Taxi C	T04A	**(59)**	N/A	N/A	1.20	<1%	**Marginal**
Taxi D	T05A	**(39)**	N/A	N/A	**(1.35)**	**(1.5% H)**	**Unsatisfactory**

Taxiways Overall Rating: **Unsatisfactory**

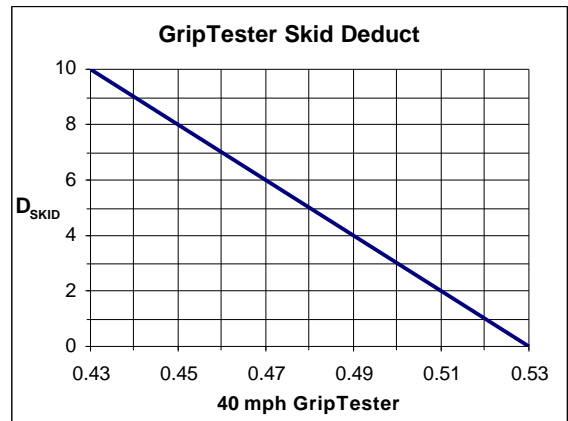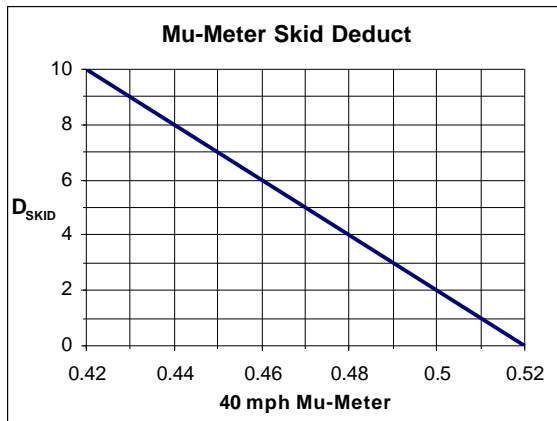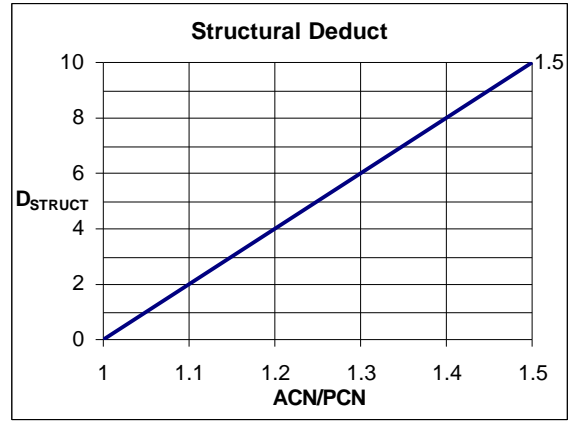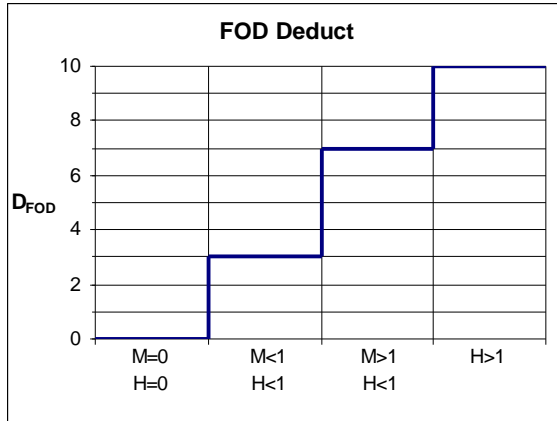| Facility	Feature	PCI	Mu(40)	Mu(60)	ACN/PCN	FOD	Rating
Apron A	A01B	77	N/A	N/A	1.0	<1%	**Adequate**
	A02B	**(59)**	N/A	N/A	1.1	<1%	**Marginal**
Apron B	A03B	72	N/A	N/A	**(1.4)**	**(1.2% H)**	**Unsatisfactory**
Aprons Overall Rating:						**Unsatisfactory**	

5.5. Reporting Ratings**.** Report ratings by facility category code in accordance with *Air Force Facility Investment Metric,* 1 August 1997. It is also recommended the ratings be displayed on a color coded Airfield Layout Plan with **green** indicating **Adequate, yellow** indicating **Marginal,** and **red** indicating **Unsatisfactory.** An example Airfield Layout Plan illustrating the ratings in 5.2 is shown below.
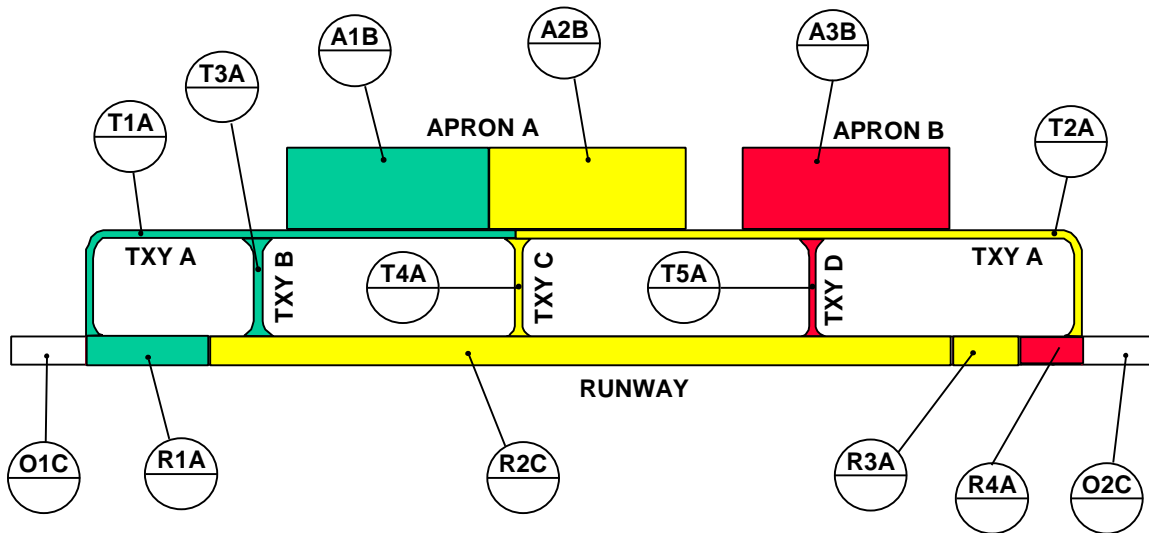
6. REQUIREMENTS PRIORITIZATION. This section explains a procedure for objectively determining a prioritized order for a group of projects that fall into the same category of the MARM.

6.1. Procedure. Determine the PCI, FOD Potential, 40 mph Mu Meter or GripTester, and ACN/PCN values. Using the charts below, determine the deduct value for FOD Potential, Structural, and Skid Potential. Subtract each deduct value from the PCI to determine a priority order.

FOD Deduct

D_{FOD}

10
8
6
4
2
0

M=0   M<1   M>1   H>1
H=0   H<1   H<1

Structural Deduct

1.5

D_{STRUCT}

10
8
6
4
2
0

1   1.1   1.2   1.3   1.4   1.5
ACN/PCN

Mu-Meter Skid Deduct

D_{SKID}

10
8
6
4
2
0

0.42   0.44   0.46   0.48   0.5   0.52
40 mph Mu-Meter

GripTester Skid Deduct

D_{SKID}

10
8
6
4
2
0

0.43   0.45   0.47   0.49   0.51   0.53
40 mph GripTester

6.2. Example: Three runway features fall within the **Degraded** category as determined by the criteria in paragraph 5.2. Pertinent information for determining the rating are:

Feature	PCI	Mu40	FOD	ACN/PCN
R11A	75	0.48	M=1.5, H=0.5	1.4
R12A	55	0.43	M=1.5	1.3
R13A	55	0.43	M=0.8	1.3

Rating for R11A=75-4-7-8=55
Rating for R12A=55-9-7-6=33
Rating for R13A=55-9-3-6=37

Priority for funding is R12A, then R13A, then R11A

6.3. Combining Features. When features are combined to form projects, use an area-weighted process for determining the rating. For example, if R12A and R13A are included in a project, the combined rating would be:

Rating(Combined)=Rating R12A(Area R12A) + Rating R13A(Area R13A)
Area R12A + Area R13A

7. NUMERICAL RATING SYSTEM. Some MAJCOMs may want to rate the general "health" of all facilities, including pavements, on a numerical rating scale. This section describes a procedure for calculating a pavement rating using a weighted PCI.

7.1. Procedure. Use a weighted PCI to determine the overall rating for a facility. The weighted PCI can be calculated manually or by the Micro-Paver computer program. Assuming a 10,000'x150'runway with R21A = 1,000'x150', R22C=8,000' x150', R23A=500'x150' and R24A=500'x150', with PCI values of 78, 70, 54, and 52 respectively , the manual computation is as follows:

Weighted PCI=R21A PCI (R21A Area) + R22C PCI (R22C Area) +**….**
R21A Area + R22C Area +**….**

Weighted PCI=78(1000'x150') +70(8,000'x150') + 54(500'x150') +52(500x150')
(1000'x150') + (8,000'x150') +(500'x150')+ (500'x150')

"Health" of Runway =69

7.2 Assessing Value Added. The above procedure can be used to determine value added to a facility by a project. For example, assume an M&R project raised the PCI of R23A and R24A to 80. The new rating for the runway is **71.8.** The project increased the "health " of the runway by 2.8 points.

7.3. Rating Scales. A MAJCOM may want to use a different scale for rating facility health. For example, it may be desirable to use a range of 85 to 100 for **Adequate**. This can be accomplished by applying a proportioning operation to the weighted PCI. The table below shows how this can be accomplished.

Rating	Weighted PCI	Proportioning Operation	Numerical Rating
Adequate (Minimal)	100	----------------------→	100
		((PCI-70)*15/30)+85	
	70	----------------------→	85
Marginal (Degraded)	69	----------------------→	84
		(PCI-55)+70	
	55	----------------------→	70
Unsatisfactory (Critical)	54	----------------------→	69
		(PCI*70/55)	
	0	----------------------→	0

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